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Conference Paper

Fiscal Policy, Monetary Regimes and Current Account Dynamics

Beiträge zur Jahrestagung des Vereins für Socialpolitik 2012: Neue Wege und Herausforderungen für den Arbeitsmarkt des 21. Jahrhunderts - Session: Fiscal Policy I, No. A11-V2

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Fiscal Policy, Monetary Regimes and Current Account Dynamics

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Abstract
The serious current account imbalances which have developed within the euro area over the last decade are at the core of the current financial crisis. For the members of the currency union fiscal policy has gained in importance due to the loss of monetary policy as an autonomous policy instrument. Based on a small open economy DSGE model with fiscal feedback rules, we analyze dynamic macroeconomic responses in particular of the current account to different shocks under alternative exchange rate regimes. Our results indicate that entry into monetary union and the subsequent loss of national monetary policy make the economy more vulnerable to a productivity shock and leads to higher variability of the real exchange rate and the current account. On the contrary, for a risk premium shock, an entry into EMU implies lower variability of most macroeconomic variables, but a higher persistence in the adjustment process of the current account. For both shocks, a countercyclical fiscal response to the current account stabilizes most macroeconomic variables better than a conventional countercyclical response to output, independently of the underlying exchange rate regime. Stabilizing the current account via fiscal policy intervention comes at the price of higher variability of output in the short-run, however.

JEL classification: E61, E62, E52, F41
Key words: Current Account Dynamics, Fiscal Policy, Monetary Policy, Euro Area

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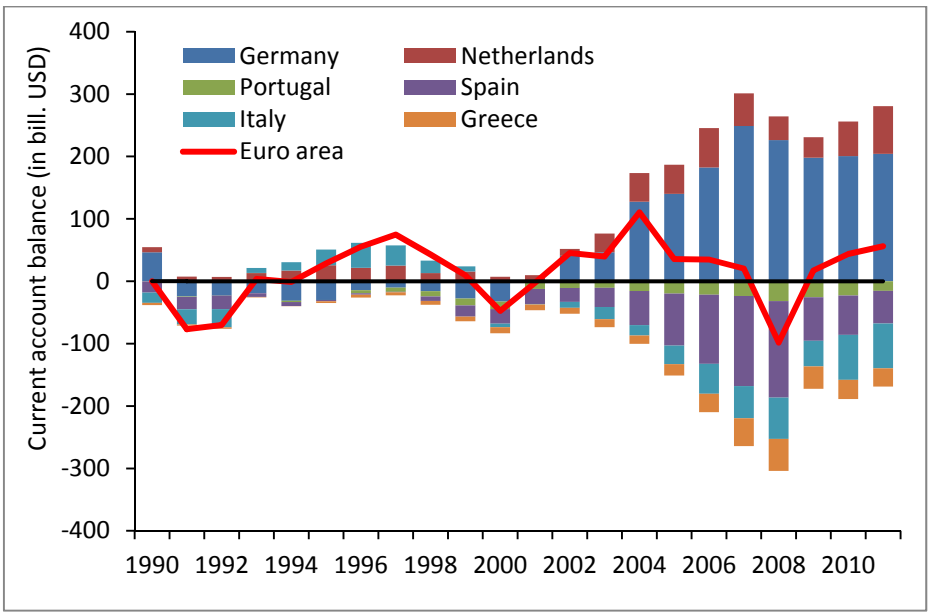
1 Introduction

The discussion on global imbalances has attracted a lot of interest and controversy in the last decade (see e.g. Bernanke, 2005; Blanchard and Milesi-Ferretti, 2012). In the mean time, regional imbalances within the euro area are on the international policy agenda, not the least due to the ongoing twin debt and banking crises. While the current account for the aggregated euro area is nearly balanced, a growing and persistent divergence has developed among EMU countries since the establishment of the monetary union in 1999 with considerable current account deficits particularly in some southern European countries like Greece, Italy, Portugal and Spain (see figure 1).

Figure 1: Current account balances in the euro area (1990-2011).



Source: World Development Indicators online database.

The debate on these imbalances has so far mainly focused on the role of capital flows for real appreciation, the subsequent loss of competitiveness, and the deterioration of the capital account, e.g. Arghyrou and Chortareas, 2008; Belke and Dreger, 2011; Zemanek et al., 2009.

Independently of the euro developments there is active discussion on the role of fiscal policy for the current account under the heading of the so called twin deficits literature (see e.g. Baxter, 1995; Beetsma et al., 2008; Monacelli and Perotti, 2010; Ali Abbas et al., 2010; Bussière et al., 2010; Bouakez et al., 2011). This analysis typically alludes to

the goods market channel with an increase in government spending raising the demand for domestic goods, appreciating the real exchange rate through relative price changes and thereby worsening the trade balance. Although there is some controversy on the empirics of this debate, especially concerning the relationship between government spending, real exchange rate and current account deficit in the US. (see e.g. Corsetti and Müller, 2006; Kim and Roubini, 2008; Monacelli and Perotti, 2010; Bouakez et al., 2011), Ali Abbas et al. (2010) reveal a statistically significant association between fiscal policy and the current account. They show for a large country sample of 124 countries over the period 1985 – 2007 that an 1 percent increase in government consumption worsens the current account by about 0.3 percent of GDP on impact, becoming insignificant after 2 – 4 years.[1] Likewise Bussière et al. (2010) show for 21 OECD countries over the period 1960 – 2003, that an increase in the government budget deficit by 1 percentage point of GDP lowers the current account by 0.14 percentage points of GDP on average. In the context of the European Union, Beetsma et al. (2008) find for 14 EU countries over the period 1970 – 2004 that an increase in public spending of 1 percent of GDP raises GDP by 1.2 percent, which leads through a decrease in net exports to a fall of the trade balance by 0.5 percent of GDP. Since government spending increases the budget deficit by 0.7 percent, the study supports the twin deficit hypothesis in the EU context.

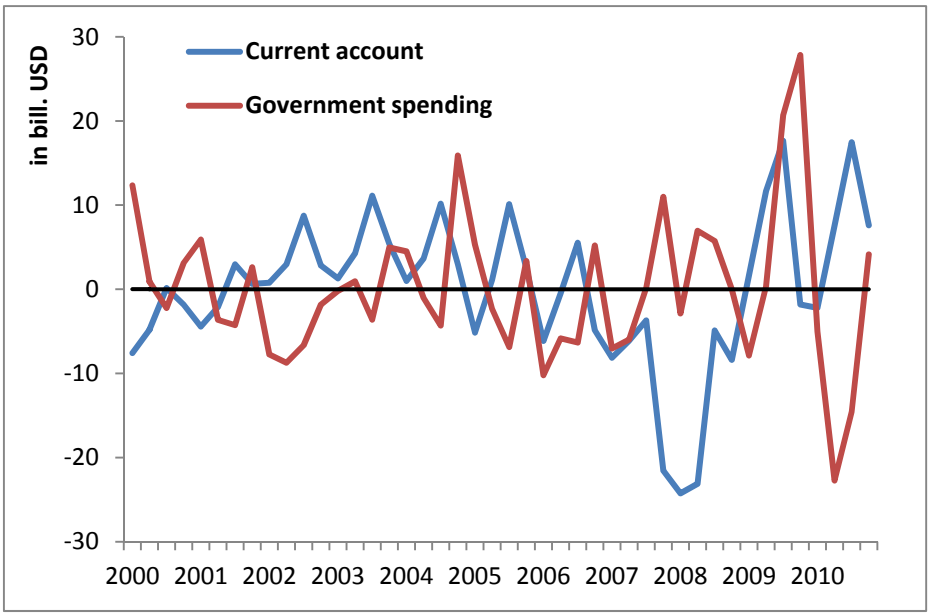
In order to reduce the growing current account deficits in the southern Euro Area countries, Jaumotte and Sodsriwiboon (2010) discuss several policy options in a currency union. They emphasize that due to the centralization of monetary policy, fiscal policy is perhaps the most crucial macroeconomic policy tool. They point out that especially in the current twin debt crisis, fiscal consolidation will remain crucial going forward, to lower public debt and reduce domestic demand pressure. The stabilization potential of fiscal policy is supported by Catalán and Lama (2006). They show for the Spanish economy that an 1 percent exogenous fall in real government spending in one quarter improves the current account balance by about 0.16 percentage points of GDP

[1] The estimations yield similar results for emerging, low-income and advanced economies. The relationship is significantly stronger when output is above potential output.

over the first year.[2] Most recently a study on fiscal consolidation and their implications for the current account was published by the IMF (2011).[3] They find that a fiscal consolidation of 1 percent of GDP results in an improvement in the current account of over 0.5 percent of GDP within two years. This relationship comes not only through a decline in domestic demand but also from an increase in exports as a result of a depreciation of the domestic currency. They point out that the current account adjustment is just as large when the nominal exchange rate is fixed, but the correction is more painful resulting in higher economic contraction and higher real exchange rate depreciation.

Figure 2 depicts exemplarily the development of government spending and current account balance for three current account deficit countries in the center of the ongoing financial crisis debate, namely Greece, Portugal and Spain.

Figure 2: Changes in current account and government spending.



Source: IHS Global Insight.

Note: Deviations from HP-filter trend.

[2] Thus, a reduction in real government spending of about 1 ½ percentage points of GDP would improve the current account by 1 percent of GDP. Government spending includes consumption and investment and was 23 percent of GDP in 1994 – 2004.

[3] This chapter in the World Economic Outlook 2011 – Slowing Growth, Rising Risks – refers on the background paper by Bluedorn and Leigh (2011).

Typically an increase in government spending is accompanied by a decrease in the current account with a short delay. This could indicate that for small open economies with large current account deficits, fiscal policy could be an important policy instrument to stabilize the current account.

The DSGE approach provides a comprehensive framework to analyze fiscal and monetary policy under alternative exchange rate regimes, i.e. being a member of the euro area or not. While the coordination and stabilizing properties of monetary and fiscal policy are at the core of the extensive DSGE literature, e.g. Beetsma and Jensen, 2005; Schmitt-Grohe and Uribe, 2007; Ferrero, 2009; Vogel et al., 2011, there are to our knowledge only few studies that focus on the role of monetary or fiscal policy to stabilize the current account. Ferrero et al. (2008) analyze the effects of alternative monetary policy regimes on the behavior of aggregate variables under two different current account rebalancing scenarios, but without considering fiscal policy rules. Di Giorgio and Nisticò (2008, 2011) study the role of stabilization policies for productivity shocks on the dynamics of net foreign assets in a two country DSGE model with overlapping generations. In addition to alternative monetary policy rules, they use a primary-deficit feedback rule for fiscal policy with countercyclical response to the output gap and the stock of public debt. For a positive productivity shock they show how a low degree of fiscal discipline, i.e. the extent to which fiscal policy reacts to outstanding debt, leads to a deterioration of the net foreign asset position in the medium run.

Our contribution to this work is to link fiscal policy rules directly to external imbalances and analyze the stabilizing properties of fiscal policy for current account imbalances. The current financial crisis makes clear how current account imbalances can cause far reaching damage to financial stability. As fiscal policy is the major policy instrument left with the individual members of a currency union it seems interesting and necessary to analyze the potential of fiscal policy rules to stabilize the current account. Specifically as the European Commission explicitly looks with her scoreboard framework into the process of macroeconomic imbalances (see European Commission, 2012), a better understanding of policy rules to stabilize the current account might be of particular interest.

The paper is organized as follows. Section 2 describes a small open economy DSGE model. The design of our monetary and fiscal policy rules with respect to alternative monetary regimes and the model calibration are given in section 3. Section 4 examines the simulation results of a negative productivity and risk premium shock to macroeconomic variables under alternative scenarios and policy rules, with focus on current account dynamics. Section 5 provides some insights on the robustness of our results. Our main findings are summarized in section 6.

2 A small open economy model

Our model is based on the small open economy literature proposed by e.g. Monacelli (2003), Gali and Monacelli (2005) and Justiniano and Preston (2010). The model includes elements that have become standard in this literature, such as nominal rigidities in price-setting, indexation of domestic prices to past inflation, incomplete pass-through of exchange rate movements to domestic inflation, habit formation in consumption and the use of Taylor rules in monetary policy. We depart from the assumption of complete risk-sharing as in Schmitt-Grohé and Uribe (2005) by introducing a country risk premium. This debt-elastic interest rate is related to the net foreign asset position. Hence, if the economy is a net borrower, domestic households are charged with a risk premium on the foreign interest rate. Due to the loss of an autonomous monetary policy within a currency union, we focus our analysis on the potential of alternative fiscal policy rules to stabilize the current account.

Households

The domestic economy is populated by a continuum of infinitely living households whose preferences are given by:

$$E_0 \sum_{t=0}^{\infty} \beta^t \left[\frac{\left(C_t - H_t\right)^{1-\sigma}}{1-\sigma} - \frac{N_t^{1+\varphi}}{1+\varphi} \right], \tag{1}$$

where N_t is labor input, $0 < \beta < 1$ is the discount factor and $H_t \equiv hC_{t-1}$ describes the external habit formation of the household. The parameters $\sigma, \varphi > 0$ are the inverse

elasticities of intertemporal substitution (or coefficient of relative risk aversion) and labor supply, respectively. C_t is a composite consumption index defined by

$$C_t \equiv \left[(1-\alpha)^{\frac{1}{\eta}} C_{H,t}^{\frac{\eta-1}{\eta}} + \alpha^{\frac{1}{\eta}} C_{F,t}^{\frac{\eta-1}{\eta}} \right]^{\frac{\eta}{\eta-1}}. \tag{2}$$

$C_{H,t}$ and $C_{F,t}$ are CES aggregators of the quantities of domestic and foreign goods:

$$C_{H,t} = \left[\int_0^1 C_{H,t}(i)^{\frac{\varepsilon-1}{\varepsilon}} di \right]^{\frac{\varepsilon}{\varepsilon-1}} \quad \text{and} \quad C_{F,t} = \left[\int_0^1 C_{F,t}(i)^{\frac{\varepsilon-1}{\varepsilon}} di \right]^{\frac{\varepsilon}{\varepsilon-1}}, \tag{3}$$

where $\eta > 0$ is the elasticity of substitution between domestic and foreign goods. The parameters α and $\varepsilon > 1$ are the share of foreign-produced goods in the consumption bundle and the elasticity of substitution between types of differentiated domestic or foreign goods, respectively.

The only available assets are domestic and foreign bonds. So that flow budget constraint of households is given by:

$$\begin{aligned} &P_t C_t + B_t + e_t nfa_t = \\ &W_t N_t + (1+i_{t-1})B_{t-1} + (1+i^*_{t-1})\phi_t(nfa_t)e_{t-1}nfa_{t-1} + \Pi_{H,t} + \Pi_{F,t} - T_t \end{aligned} \tag{4}$$

The left hand side corresponds to the uses of the resources. Households can utilize these to consume goods or to purchase new bonds, where B_t is the amount of one-period domestic bonds and nfa_t the amount of one-period foreign currency denominated bonds. e_t is the nominal exchange rate. The right hand side represents the resources at the beginning of period t, where $W_t N_t$ is the wage earning, $\Pi_{H,t}$ and $\Pi_{F,t}$ denote profits from holding shares in domestic and imported goods firms and T_t implies lump-sum taxes. Following Benigno (2009) and Schmitt-Grohe and Uribe (2005), the term $\phi_t(nfa_t)$ is a premium on foreign bond holdings, defined as

$$\phi_t = \exp\left[-\chi(nfa_t) + \tilde{\phi}_t \right],$$

where

$$nfa_t \equiv \frac{e_t NFA_t}{P_t}$$

is the real aggregate net foreign asset position of the domestic economy and $\tilde{\phi}_t$ a risk premium shock. The function $\phi_t(nfa_t)$ captures the costs for domestic households of doing transactions in the international asset market. Hence, as net borrowers, domestic households are charged a premium on the foreign interest rate; as net lenders, they receive a remuneration lower than the foreign interest rate. This functional form ensures stationarity of the foreign debt level in a log-linear approximation to the model.

For any given expenditure, the household optimization problem yields the demand for each category of goods:

$$C_{H,t}(i) = \left(\frac{P_{H,t}(i)}{P_{H,t}}\right)^{-\varepsilon} C_{H,t} \quad \text{and} \quad C_{F,t}(i) = \left(\frac{P_{F,t}(i)}{P_{F,t}}\right)^{-\varepsilon} C_{F,t} \tag{5}$$

for all $i \in [0,1]$, where the price indices of the domestic and foreign consumption bundles are

$$P_{H,t} \equiv \left[\int_0^1 P_{H,t}(i)^{1-\varepsilon} di\right]^{\frac{1}{1-\varepsilon}} \quad \text{and} \quad P_{F,t} \equiv \left[\int_0^1 P_{F,t}(i)^{1-\varepsilon} di\right]^{\frac{1}{1-\varepsilon}}.$$

Assuming symmetry across all i goods, the optimal allocation of expenditures between domestic and foreign goods implies the demand functions

$$C_{H,t} = (1-\alpha)\left(\frac{P_{H,t}}{P_t}\right)^{-\eta} C_t \tag{6}$$

and

$$C_{F,t} = \alpha\left(\frac{P_{F,t}}{P_t}\right)^{-\eta} C_t, \tag{7}$$

where the consumer price index (CPI) is defined as

$$P_t \equiv \left[(1-\alpha)P_{H,t}^{1-\eta} + \alpha P_{F,t}^{1-\eta}\right]^{\frac{1}{1-\eta}}. \tag{8}$$

.

The following optimality conditions, derived by maximizing equation (1) subject to constraint (4), must hold in equilibrium:

$$\frac{N_t^{\varphi}}{\left(C_t - H_t\right)^{-\sigma}} = \frac{W_t}{P_t} \tag{9}$$

$$\beta E_t\left[\left(\frac{\left(C_{t+1} - H_{t+1}\right)}{\left(C_t - H_t\right)}\right)^{-\sigma}\left(\frac{P_t}{P_{t+1}}\right)\right] = \frac{1}{(1+i_t)}, \tag{10}$$

$$\beta E_t\left[\left(\frac{\left(C_{t+1} - H_{t+1}\right)}{\left(C_t - H_t\right)}\right)^{-\sigma}\left(\frac{P_t}{P_{t+1}}\right)\left(\frac{e_{t+1}}{e_t}\right)\right] = \frac{1}{(1+i_t^*)\phi(nfa_t)}. \tag{11}$$

Equation (9) gives us the first order condition of the consumer's problem for making the intratemporal choice between labor and leisure. It states that the marginal rate of substitution between consumption and labor is equal to the real wage at any point of time. The intertemporal first order condition is given by equation (10), which is the standard Euler equation for the holding of domestic bonds. Similarly, equation (11) is the optimality condition for the holding of foreign bonds.

Following the small open economy literature (see, e.g., Beltran and Draper, 2008), the small open economy is assumed to be of negligible size relative to the rest of the world, which allows us to treat the latter as a closed economy. For the foreign economy, output equals domestic consumption and CPI inflation equals domestic inflation.

Domestic Producers

Differentiated domestic goods are produced by a continuum of monopolistically competitive firms owned by consumers. Each firm produces with a linear technology represented by the production function $Y_t(i) = A_t N_t(i)$, where A_t is an exogenous productivity shock. We further assume that firms set prices in a staggered fashion as in Calvo (1983). Hence, in any period t only $\left(1-\theta_H\right)$ firms are allowed to adjust their prices and maximize their expected discounted value of profits

$$E_t \sum_{T=t}^{\infty} \theta_H^{T-t} \beta_{t,T} Y_{H,T}(i)\left[P_{H,t}(i) - P_{H,T} MC_{H,T}\right]$$

subject to the demand function

$$Y_{H,T}(i) = \left(\frac{P_{H,T}(i)}{P_{H,T}}\right)^{-\varepsilon}\left(C_{H,T} + C^*_{H,T}\right),$$

where $MC_{H,T} = W_T / P_{H,T}$ is the real marginal cost. θ_H^{T-t} is the probability that the domestic firm will not be able to adjust its price during the next $(T-t)$ periods.

The first order condition is then

$$E_t \sum_{T=t}^{\infty} \theta_H^{T-t} \beta_{t,T} Y_{H,T}(i)\left[P_{H,T}(i) - \frac{\theta_H}{\theta_H - 1} P_{H,T} MC_{H,T}\right] = 0 . \tag{12}$$

Retail Firms

For incomplete exchange rate pass-through we follow Monacelli (2003). Retail firms import foreign differentiated goods and have a small degree of pricing power because they are assumed to be monopolistically competitive. When selling imported goods to domestic consumers they will charge a mark-up over their cost. In the short run, this creates a wedge between the world market price of foreign goods paid by importing firms $\left(e_t P^*_{F,t}\right)$ and the domestic currency price of these goods when they are sold to consumers $\left(P_{F,t}\right)$. The so called "law of one price (l.o.p.) gap" (see Monacelli, 2003) is defined as:

$$\Psi_{F,t} = \frac{E_t P^*_{F,t}}{P_{F,t}} \tag{13}$$

Retail firms also operate under Calvo-style price setting, with θ_F being the fraction of firms not allowed to set prices optimally in any period t. These maximize the expected stream of discounted profits

$$E_t \sum_{T=t}^{\infty} \theta_F^{T-t} \beta_{t,T} C_{F,T}(i)\left[P_{F,t}(i) - e_T P^*_{F,T}\right]$$

subject to the demand curve

$$C_{F,T}(i) = \left(\frac{P_{F,T}(i)}{P_{F,T}}\right)^{-\varepsilon} C_{F,T} .$$

The associated first order condition yields:

$$E_t \sum_{T=t}^{\infty} \theta_F^{T-t} \beta_{t,T} C_{F,T}(i) \left[P_{F,T}(i) - \frac{\theta_F}{\theta_F - 1} e_T P_{F,T}^* \right] = 0 . \tag{14}$$

Uncovered Interest Rate Parity

Because we depart from the assumption of complete risk-sharing and allow for incomplete asset markets, we derive the uncovered interest rate parity condition through the asset-pricing condition in equations (10) and (11), which determine domestic and foreign bond holdings:

$$(1+i) = (1+i^*)\phi(nfa_t)\left[\frac{e_{t+1}}{e_t}\right]. \tag{15}$$

In periods when the economy is a net borrower (net lender), the domestic interest rate is higher (lower) than the foreign interest rate. Thus, movements in the net foreign asset position affect the interest rate differential of the domestic and foreign economy.

Government

To investigate the potential stabilizing effects of fiscal policy to correct current account imbalances by regulating domestic demand, we assume that the government only purchases domestically-produced goods. The public consumption index is given by

$$G_{H,t} = \left[\int_0^1 G_{H,t}(i)^{\frac{\varepsilon-1}{\varepsilon}} di \right]^{\frac{\varepsilon}{\varepsilon-1}} \tag{16}$$

where $G_{H,t}(i)$ is the quantity of domestic good i purchased by government. For any given level of public consumption, the government allocates expenditures across goods in order to minimize total cost. Minimization of $P_H G_H$ under restriction (16) yields the government demand function:

$$G_{H,t}(i) = \left(\frac{P_{H,t}(i)}{P_{H,t}} \right)^{-\varepsilon} G_{H,t} . \tag{17}$$

Government spending is financed either through lump-sum taxes[4] to domestic households T_t or by nominal debt denominated in local currency B_t. This yields the government's flow budget constraint, in nominal terms:

$$B_t = (1+i_{t-1})B_{t-1} + G_{H,t} - T_t, \tag{18}$$

where $G_{H,t} - T_t$ denotes the nominal primary deficit (see Di Giorgio and Nisticò, 2011; Corsetti et al., 2009).[5] The detailed government spending feedback rules are defined in section 3.

Terms of Trade, Real Exchange Rate and the Current Account

Terms of trade are defined as

$$S_t = \frac{P_{F,t}}{P_{H,t}}. \tag{19}$$

The domestic terms of trade is the price of foreign goods (imports) per unit of domestic goods (exports). An increase in S_t is therefore equivalent to an increase in competitiveness. The real exchange rate is defined as

$$Q_t = \frac{e_t P_t^*}{P_t}, \tag{20}$$

the ratio of CPIs expressed in a common currency, where an increase in Q_t implies a depreciation of the home currency and thus an increase in competitiveness.

Finally, real net foreign assets evolve according to

$$\frac{e_t NFA_t}{P_t} = \frac{(1+i_{t-1})}{(1+\pi_H)}\phi_t\left(\frac{e_{t-1}NFA_{t-1}}{P_{t-1}}\right) + NX_t, \tag{21}$$

where NX_t denotes net exports and is the difference between output and absorption:

$$NX_t = \frac{P_{H,t}}{P_t}Y_t - (C_t + G_t). \tag{22}$$

The current account reflects the change in real net foreign assets:

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[4]. We use lump-sum taxes for simplicity, because they do not directly affect intertemporal decisions of the households.

[5] The introduction of an explicit tax feedback rule with a parameter that captures the responsiveness of taxes to government debt, as in Corsetti (2009), gives no further insights and is therefore omitted.

$$CA_t = \frac{e_t NFA_t - e_{t-1} NFA_{t-1}}{P_t}. \tag{23}$$

The derivation of the log-linear model is shown in appendix B, equation (35) to (53). The design of the monetary policy rules with respect to the exchange rate regime is described in section 3.

The foreign economy

We follow the small open economy literature and assume that the foreign economy is large enough to be characterized by the closed-economy version of the model above. It is reasonable to interpret that the foreign country represents the rest of the euro area and can be fully described by the following dynamic equations:

$$y_t^* - hy_{t-1}^* = E_t\left(y_{t+1}^* - hy_t^*\right) - \frac{1}{\sigma}(1-h)\left(i_t^* - E_t\left\{\pi_{t+1}^*\right\} - \varepsilon_{pref,t}^*\right) \tag{24}$$

and

$$\pi_t^* = \beta E_t\left\{\pi_{t+1}^*\right\} + \kappa_F mc_t^* + \varepsilon_{\pi,t}^* \tag{25}$$

with

$$mc_t^* = \varphi y_t^* + \alpha s_t + \frac{\sigma}{1-h}\left(y_t^* - hy_{t-1}^*\right) - (1+\varphi)a_t^* \tag{26}$$

and $\varepsilon_{\pi,t}^*$ is an exogenous shock to foreign inflation. The foreign monetary policy follows a Taylor-type rule, e.g.:

$$i_t^* = \rho_{i*} i_{t-1}^* + (1-\rho_{i*})\left(\omega_{\pi*}\pi_t^* + \omega_{\hat{y}*}\hat{y}_t^*\right) + \varepsilon_{i*,t}, \tag{27}$$

where $\varepsilon_{i*,t}$ is an exogenous monetary policy shock.

3 Monetary and fiscal policy: Targeting rules vs. instrument rules

Both, outside of and within a currency union the interaction of monetary and fiscal policies affects macroeconomic adjustments. Concerning the design of alternative monetary regimes and fiscal policy rules and their response to current account imbalances, we distinguish between (I) simple instrument rules and (II) optimal policy

rules.[6] The advantage of simple rules is that they are easy to implement and for the public to understand. In order to compare the simple rules with an optimal policy we study an optimal policy rule under discretion where government takes private expectations as given and re-optimizes the policy each period. The instrument rules of our model are structured as follows:

Before monetary union the monetary authorities of both countries act independently and are assumed to follow a Taylor-rule (see Taylor, 1993):

$$i_t = \rho_i i_{t-1} + (1-\rho_i)(\omega_\pi \pi_t + \omega_{\hat{y}} \hat{y}_t) + \varepsilon_{i,t}, \tag{28}$$

where ρ_i is the degree of interest rate smoothing and ω_π, $\omega_{\hat{y}}$ are relative weights on inflation and output gap respectively. The output gap $\hat{y}_t = y_t - \overline{y}_t$ is the difference between actual output and steady state output.[7] The residual variable $\varepsilon_{i,t}$ is an exogenous monetary policy shock.

With the final stage of the European Monetary Union, the small open economy adopts the euro area currency with the corresponding loss of an autonomous monetary policy. Thus, the exchange rate in our EMU model is exogenous and the interest rate is set solely by the foreign central bank (equation 27). Therefore, the nominal interest rate in the small open economy is defined by:

$$i_t = i_t^* + \text{risk} \tag{29}$$

Concerning fiscal policy, the governments' real flow budget constraint is defined as:

$$b_t = (1 + i_{t-1} - \pi_H) b_{t-1} + g_t, \tag{30}$$

[6] According to Rudebusch and Svensson (1998) and Svensson (2000, 2003), targeting rules determine the optimal policy responses given a set of objectives. It minimizes the objective loss function that deviates from a target variable.

[7] Some theoretical and empirical literature on monetary policy rules examines a feedback to output growth rather than to output gap (see, e.g., Walsh, 2003; Stracca, 2006; Choi and Wen, 2010). We have checked both rules for robustness in section 4 yielding negligible differences for our further analysis.

where $b_t = \frac{B_t}{P_{H,t}}$ is the real debt denominated in local currency. We assume that government spending g_t is determined by an endogenous fiscal policy rule, according to Taylor (2000):[8]

$$g_t = \rho_g g_{t-1} + (1-\rho_g)(-\omega_g (y_{t-1} - y_{t-2}) - \omega_b b_{t-1} + \omega_{ca} ca_{t-1}) + \varepsilon_{g,t}, \qquad (31)$$

where ρ_g is the degree of instrument smoothing and $\omega_g, \omega_b, \omega_{ca}$ are relative weights for output growth, the stock of public debt, and the current account, respectively. The residual term $\varepsilon_{g,t}$ is an exogenous fiscal policy shock. We use this enhanced feedback rule to investigate the dynamic implications of fiscal policy as a stabilization tool. The parameter ω_g determines to which degree fiscal policy is used to stabilize output growth.[9] The automatic stabilizer includes a 1-quarter delay for taking into account an implementation or reaction lag.[10] To account for the aim of fiscal discipline we follow, e.g. Schmidt-Grohe and Uribe (2007), Forni et al. (2009) and Di Giorgio and Nisticò (2011), and introduce the term $\omega_b b_{t-1}$, which captures the degree to which the dynamics of public debt are of concern to the fiscal authorities.[11] With this formulation we can not only ensure long-run debt sustainability but can also account for the European Stability and Growth Pact, namely that the debt ceilings are in practice not strictly binding due to a number of provisional clauses.[12]

To analyze the stabilization potential of a current account stabilizing fiscal policy, we introduce an additional feedback to lagged current account.[13] The parameter ω_{ca}

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[8] This type of countercyclical fiscal policy feedback rule – without the response to the current account – is comparable with a primary deficit-rule, which has become increasingly popular to characterize discretionary fiscal policy in empirical literature (see e.g. Gali and Perotti, 2003; Favero and Monacelli, 2005; Forni et al., 2009).

[9] The stabilization of output growth, rather than output gap, is consistent with empirical evidence, that primary balance in OECD economies are more sensitive to output growth (see Fatas and Mihov 2009).

[10] This is in line with Kirsanova et al. (2007), whereas, e.g., Di Giorgio and Nistico (2011), Ferrero (2009) and Gali and Monacelli (2008) use contemporaneous feedback rules.

[11] With that introduction of „fiscal discipline“ we focus on „passive“ fiscal rules (in the sense of Leeper, 1991). This type of „Ricardian“-fiscal policy ensures that fiscal solvency is met at all times. A combination of an active monetary policy and passive fiscal policy produces internally stable adjustment dynamics and a unique steady-state.

[12] Canzoneri et al. (2004) use a similar approach to take into account the Stability and Growth Pact (SGP) without explicitly implementing the three percent deficit ceiling.

[13] We assume a 1-quarter delay for an implementation or reaction lag of one period, too.

measures the extent to which fiscal policy is used to stabilize current account imbalances. More specifically, if the home country runs a current account deficit, the fiscal authority should reduce government spending to increase net exports, thereby diminishing the external deficit.

Considering (II), a targeting rule implies the use of all relevant available information in order to minimize a loss function over expected future deviations of the target variable from the target level (see Rudebusch and Svensson, 1998). Following e.g. Gali and Monacelli (2005); Moons et al. (2007) and Svensson (2003), we consider an intertemporal loss function in quarter t:

$$E_t \sum_{T=0}^{\infty} \beta^T L_{t+T} , \tag{32}$$

with the period loss function

$$L_t = \pi_t^2 + \lambda_y \hat{y}_t^2 + \lambda_g \hat{g}_t^{\,2} + \lambda_{ca} ca_t^2 , \tag{33}$$

where $\lambda_y, \lambda_g, \lambda_{ca}$ are the weights on output growth, government spending, and current account, respectively. Following the optimal policy literature, we set the relative weight on output growth to $\lambda_y = 1$ and account for costs of fiscal policy intervention by assigning λ_g to 0.2 (see e.g. Kirsanova et al., 2007; Schmitt-Grohe and Uribe, 2007; Gali and Monacelli, 2008). We introduce the current account with a weight of $\lambda_{ca} = 0.5$ to account for the emergence of external imbalances in the loss function.

As highlighted in Rudebusch and Svensson (1998) and Svensson (2003), when $\beta \to 1$, the value of the intertemporal loss function approaches the infinite sum of unconditional means of the period loss function $E[L_t]$. Hence, the intertemporal loss function can be interpreted as the unconditional mean of the period loss function, which equals the weighted sum of unconditional variances of the variables. As a result, we are able to measure the loss function by weighting inflation, output growth, current account and fiscal instrument variability in the following manner:

$$E[L_t] = Var[\pi_t] + \lambda_y Var[\hat{y}_t] + \lambda_g Var[\hat{g}_t] + \lambda_{ca} Var[ca_t]. \tag{34}$$

Calibration

We parameterize the model on a quarterly frequency based on previous studies. The parameter values refer to empirical findings from the small open economy literature, most of them for the euro area (see, e.g., Gali and Monacelli, 2005; Smets and Wouters, 2002, 2003, 2005; Ferrero, 2009). The value for the discount factor $\beta = 0.99$ implies an annual return of about 4 percent in the steady state. The coefficient of relative risk aversion is set to $\sigma = 1.5$ and implies an elasticity of intertemporal substitution of $2/3$, which determines the sensitivity of consumption growth to changes in the real interest rate.[14] The parameter $\varphi = 4$ implies a labor supply elasticity of $1/\varphi = 0.25$, which is in the range of microeconomic estimates (e.g. Evers et al., 2008). The elasticity of substitution between domestic and foreign goods equals $\eta = 1.5$. The value α for the degree of openness is assumed to be 0.4, which roughly corresponds to the import/GDP ratio in small open euro area economies. The degree of habit persistence is set to $h = 0.7$. Calvo price stickiness θ is determined to 0.75, a value consistent with an average period of one year between price adjustments (see Altissimo et al., 2006). The share of government spending in GDP is set to $\rho_{gov} = 0.2$, which is the average value for small EMU members countries. The debt-elastic premium on foreign bond holdings is $\chi_t = 0.01$, which implies that a 1 percentage-point deterioration of the NFA/GDP position raises annualised borrowing rates by 0.04 percentage-points.[15] The monetary policy parameters are based on standard Taylor-type rule estimations and commonly employed in the literature. The degree of interest rate smoothing is determined by the persistence value of $\rho_i = 0.75$. The feedback coefficients of inflation and output gap are set to $\omega_\pi = 1.5$ and $\omega_{\hat{y}} = 0.125$ (corresponding to 0.5 for annual rates), respectively.

Regarding fiscal policy, the automatic stabilizer, $-\omega_g$, is set to 0.4 in our instrument rules (see Moons et al., 2007).[16] To ensure stability of debt accumulation process, the feedback on past debt takes the value $\omega_b = -0.02$ (see Corsetti et al., 2009; Motta and

[14] For a discussion of the wide variance in the empirical estimates of CRRA see Beltran (2007).
[15] An external risk premium of this magnitude has been recently estimated for Spain by Aspachs-Bracons and Rabanal (2009).
[16] Taylor (2000) has estimated the automatic stabilizer for the US economy to -0.5.

Tirelli, 2011). The parameter ρ_g reflects the fiscal flexibility to adjust fiscal policy in the short-run. While empirical findings about fiscal smoothing ranges between 0.4 and 0.9 (see, e.g., van Aarle, 2004; Corsetti et al., 2009), DSGE literature often sets fiscal rules without a smoothing parameter. Concerning the trade-off between flexibility of fiscal rules in DSGE models and empirical findings, we set the smoothing parameter to $\rho_g = 0.2$, allowing for difficulties in changing government spending. Depending on the response coefficient ω_{ca}, we distinguish between $\omega_{ca} = 0$ and $\omega_{ca} = 1.5$.[17] An overview of the model calibration is given in table A1 at the appendix.

4 Policy rules and current account dynamics

In this section we study the effects of different shocks on macroeconomic variables, especially the current account dynamics, under alternative monetary regimes and policy rules.[18] Within the scenario, we distinguish between the effects of being outside and inside of the European Monetary Union.[19]

Concerning the design of fiscal policy rules to correct current account imbalances, we analyze the following scenarios: (i) no active fiscal policy, $g_t = 0$, (ii) a conventional fiscal policy without current account response, $\omega_{ca} = 0$, (iii) a current account stabilizing fiscal policy as in equation (31) with $\omega_{ca} = 1.5$, (iv) a fiscal targeting rule, in which the fiscal authority chooses its policy parameters ω_g, ω_{ca} to minimize the loss function derived in equation (33).

We concentrate our analysis on productivity shocks and risk premium shocks, which are seen as main driving forces of current account imbalances within the euro area (see Belke and Dreger, 2011). All shocks are assumed to be unanticipated (stochastic), to occur in period 0, and to be uncorrelated.

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[17] We provide some insights to the robustness and relative efficiency of the fiscal rule by displaying efficiency frontiers of both, fiscal smoothing parameter ρ_g and the feedback term ω_{ca} in section 5.

[18] Our computations are performed using DYNARE toolbox for Matlab (see Adjemian et al., 2011).

[19] We use standard deviations to compare the efficiency of alternative policy rules (see e.g. Taylor, 1993).

The dynamic response to a negative productivity shock

We assume that the productivity shock evolves as a stationary AR(1) process:

$$a_t = \rho_a a_{t-1} + \varepsilon_{a,t}$$

with a persistence parameter $\rho_a = 0.7$.[20] Table 1 gives an overview of the standard deviations of macroeconomic variables to a negative productivity shock under the four alternative fiscal policy rules in the non-EMU scenario.

Table 1: Standard Deviations of fiscal policy rules in the non-EMU scenario.

Variable	Standard Deviations in %			
Fiscal policy rule	(i)	(ii)	(iii)	(iv)
	$g_t = 0$	$\omega_g = 0.4$ $\omega_{ca} = 0$	$\omega_g = 0.4$ $\omega_{ca} = 1.5$	$\omega_g = 0.7$ $\omega_{ca} = 1.33$
Consumption	0.5119	0.5108	0.4919	0.4929
Output growth	0.3431	0.3395	0.3467	0.3418
Real exchange rate	0.3362	0.3399	0.2878	0.2955
Government spending	0.0000	0.1186	0.7838	0.6768
Inflation	0.3376	0.3394	0.3226	0.3256
Interest Rate	0.2212	0.2225	0.2014	0.2045
Net foreign assets	4.3998	4.4054	3.9594	4.0071
Current account	0.6681	0.6750	0.5846	0.5984

Comparing fiscal policy rules (i) and (ii), the simulations show that conventional fiscal policy (ii) can help stabilizing output with marginal deteriorations for most other macroeconomic variables, e.g. real exchange rate and the current account. Due to the decline in output – caused by the negative productivity shock – an increase in government spending raises the demand for domestic goods, increases domestic

[20] Di Giorgio and Nisticò (2011) estimate the persistence value of 0.7 for the euro area using quarterly HP-filtered data on labor productivity for the period 1970:1 to 2005:4. Vogel et al. (2011) estimate the AR(1) process for labor productivity in 1999:1 to 2009:4 by using the percentage deviations in the small EMU-12 countries from the EMU-12 average and yields 0.643.

inflation which induces among others a higher real exchange rate appreciation and worsens the current account.

The most relevant findings arise by comparing fiscal rules (ii) and (iii). A fiscal response to the current account (iii) can stabilize the current account as well as most other macro variables. Due to the cyclical response of government spending to the current account, the stabilizing effects are accompanied with a higher variability of the output, however. Hence, fiscal policy faces a trade-off between stabilizing current account and output. The optimal fiscal policy (iv) shows similar results. In order to minimize the loss function (equation 33), fiscal policy chooses a higher relative response to output – compared to fiscal rule (iii) – and therefore achieves a better stabilizing effect of output at the expense of higher standard deviations of other macro variables. Summing up, the stronger the government spending response to the current account, the higher the stabilizing effects for the current account and most macro variables at the expense of higher output variability in the short run.

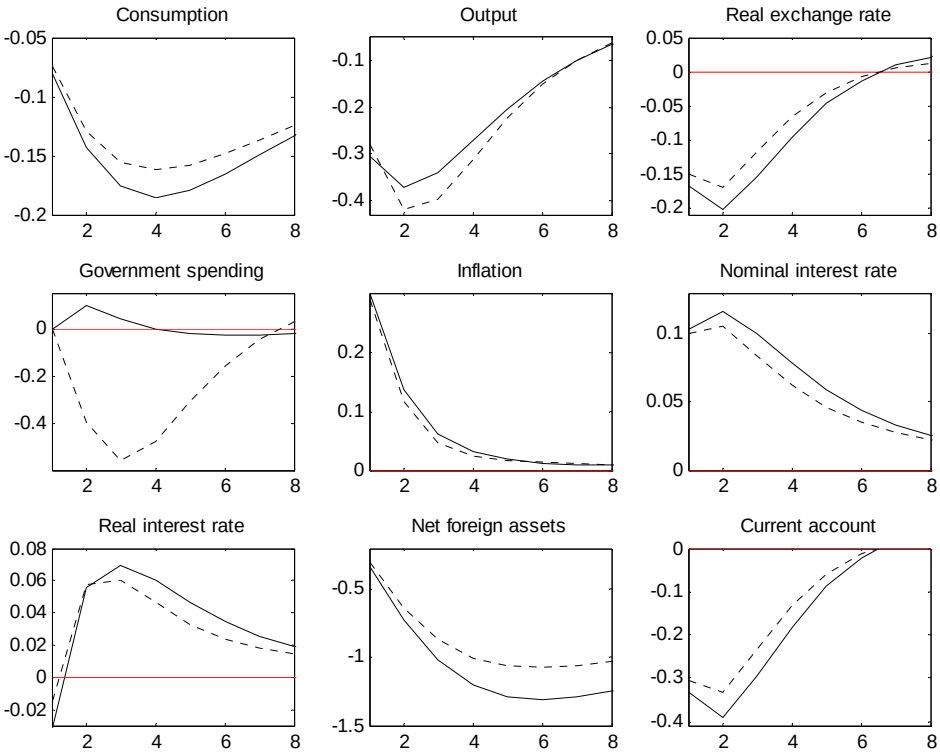
Figure 1 illustrates these dynamic responses. A negative productivity shock raises marginal costs, which induces an increase in domestic inflation and a rise of nominal interest rate by monetary policy. As a result, the terms of trade improve and the real exchange rate appreciates, implying a worsening of international competitiveness. This contributes to a decline in output and a current account deficit over the trade channel. Furthermore, the current account deficit is aggravated via the accumulation of foreign debts and the households' efforts to smooth consumption.

When fiscal policy reacts according to rule (ii), government raises spending in order to stabilize output.[21] The discrepancies to scenario (iii) in which fiscal policy responds to the current account deficit are shown by the dotted lines in figure 1. In order to reduce the current account deficit, government spending decreases. Therefore, fiscal policy can stabilize not only the real exchange rate and the current account, but also consumption and net foreign assets. A smaller increase of the nominal interest rate and an almost constant inflation decreases the real interest rate and stabilizes consumption, accompanied with less accumulated foreign debts. These stabilizing effects of macro

[21] For fiscal rule (i), the differences in magnitude of dynamic responses are negligible compared to fiscal rule (ii) – the solid lines in figure 1 – and are therefore omitted for clarity reasons.

variables are more efficient compared to fiscal policy rule (ii), but with a deterioration of the output in the short run.

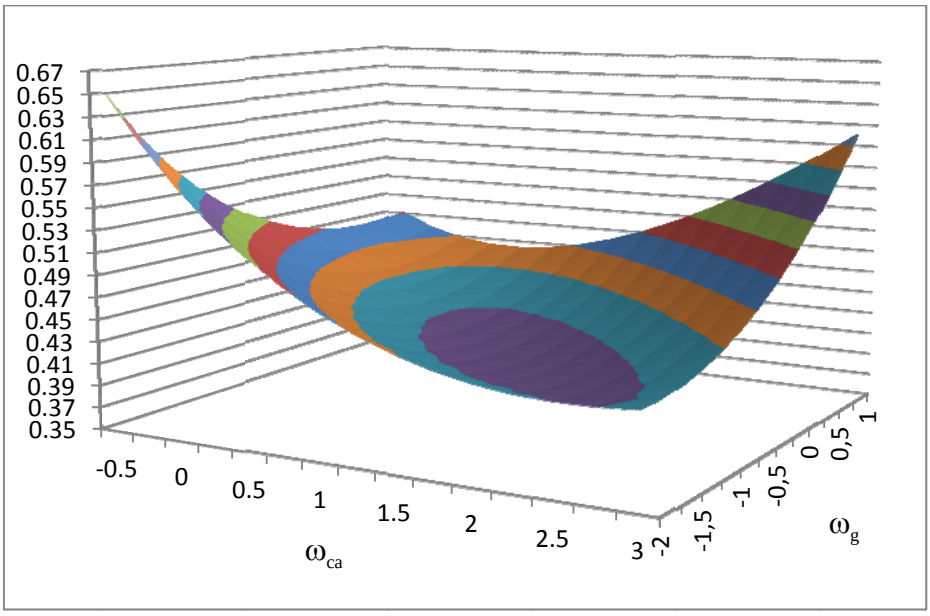
Figure 1: Impulse response functions for a negative productivity shock in a non-EMU-scenario.



Note: The solid line is the dynamic response of fiscal rule (ii); the dotted line shows the response of fiscal rule (iii).

For a better insight on the trade-off between stabilizing current account and output the policy makers face, we display loss surfaces for various combinations of fiscal policy parameters ω_g and ω_{ca}. Losses are calculated based on equation (34) for alternative combinations of fiscal reaction parameters (ω_g and ω_{ca}) in the interval [1;-2] and [-0.5;3]. Figure 2 displays the governments' losses in case of a negative productivity shock in the non-EMU scenario.

Figure 2: Loss surface for optimal fiscal rule (iv).



The loss is minimized for the fiscal parameter combination of $\omega_g = -1$ and $\omega_{ca} = 1.75$. Furthermore, the loss surface reveals another interesting insight. We can see a relatively stable area with low loss variation for the combinations (ω_g and ω_{ca}) in the interval [0;-1.5] and [1;2.5], respectively. This area exposes relative weights of the two fiscal policy parameters. Therefore, fiscal response to the current account should be a bit higher relatively to the fiscal response to output. Outside of the area, a more conventional fiscal rule (decrease in ω_g) as well as a more current account stabilizing fiscal rule (increase in ω_{ca}) leads to higher losses, because the former stabilizes output at the expense of higher variability of the current account and the latter stabilizes the current account at the expense of higher output variability.

In the next step we analyze the consequences for the small open economy when joining the EMU. Comparing the standard deviations of the macroeconomic variables in table 2, similar results as in the non-EMU scenario become evident. A fiscal response to the current account (iii) stabilizes the current account as well as most other macro variables, but is accompanied with a higher variability of the output. Another interesting aspect is

the increase in macroeconomic volatility that is associated with the EMU entry (see table 2 and 1).

Table 2: Standard Deviations for a negative productivity shock in the EMU scenario.

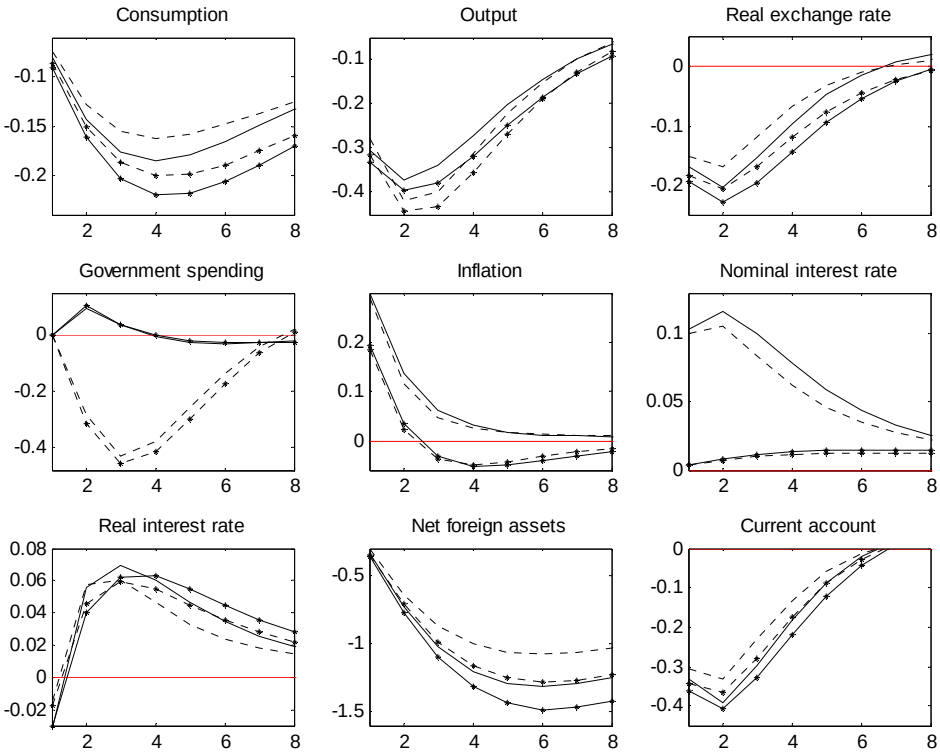
Variable	Standard Deviations in % (EMU scenario)			
Fiscal policy rule	(i)	(ii)	(iii)	(iv)
	$g_t = 0$	$\omega_g = 0.4$ $\omega_{ca} = 0$	$\omega_g = 0.4$ $\omega_{ca} = 1.5$	$\omega_g = 0.68$ $\omega_{ca} = 1.24$
Consumption	0.6210	0.6203	0.5965	0.5995
Output growth	0.3667	0.3635	0.3774	0.3710
Real exchange rate	0.4078	0.4113	0.3617	0.3715
Government spending	0.0000	0.1268	0.8743	0.7058
Inflation	0.2166	0.2191	0.2058	0.2095
Interest Rate	0.0495	0.0496	0.0446	0.0454
Net foreign assets	4.9476	4.9567	4.4635	4.5450
Current account	0.7335	0.7409	0.6497	0.6687

This increased vulnerability is confirmed by the dynamic responses in figure 3, which show both, the dynamic responses for a negative productivity shock in the non-EMU scenario and the EMU scenario. Due to the loss of an autonomous monetary authority and the adoption of the euro, the nominal exchange rate is now exogenous for the small open economy. The small increase in the nominal interest rate is not induced by monetary policy, but via a positive risk premium, because the economy becomes a net borrower.

Entry into EMU implies a higher variability and more persistence in the adjustment process of some macroeconomic variables, e.g. the real exchange rate. A more persistent appreciation and a decrease in competitiveness produce higher negative output growth and higher current account deficits. As in the non-EMU scenario, stabilizing the current account is accompanied with higher output variability. Although a current account stabilizing fiscal policy plays an important role to reduce the

variability of net foreign assets and the current account, it is not able to fully compensate the absence of an autonomous monetary policy.

Figure 3: Impulse response functions for a negative productivity shock inthe EMU and non-EMU scenario.



Note: The solid and dotted lines are the dynamic responses of fiscal rules (ii) and (iii) of figure 1 (non-EMU scenario) as a benchmark. The marked (*) solid and dotted lines show the effects of fiscal rule (ii) and (iii) in the EMU-scenario, respectively.

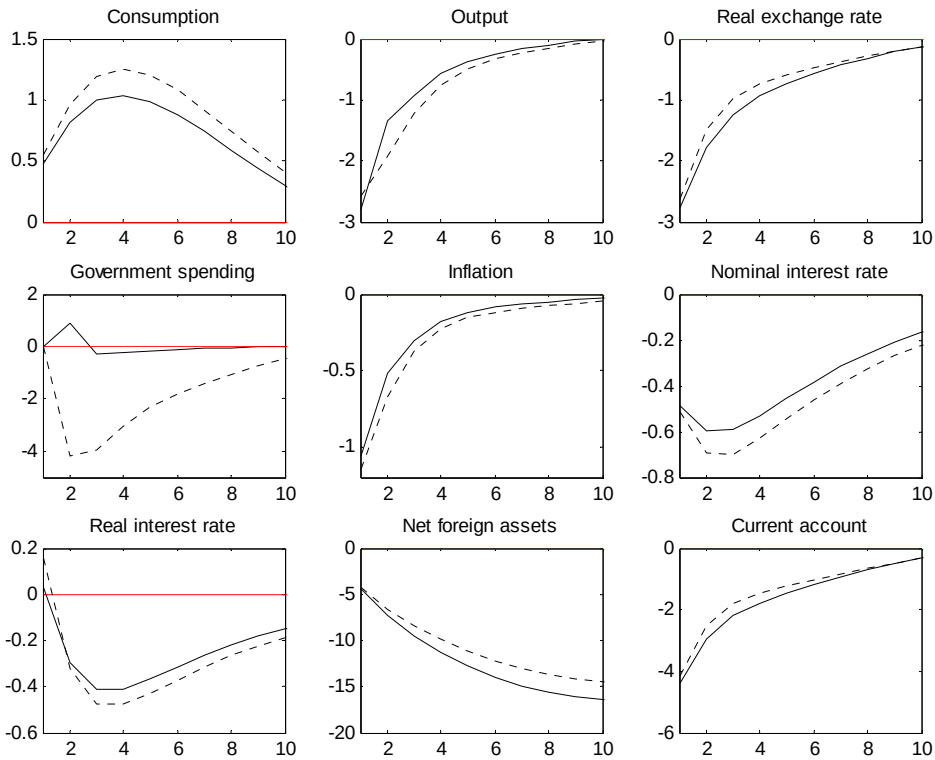
The dynamic response to a negative risk premium shock

A specific development during the establishment of EMU was the sharp drop in long-run interest rates, which was associated with a drastic decline of government bond spreads within the euro area (see figure A1 in the appendix). We analyze such a negative risk premium shock, defined as a stationary AR(1) process:

$$\varepsilon_{risk,t} = \rho_{risk}\varepsilon_{t-1}^{risk} + \Phi_{risk,t},$$

where ρ_{risk} is set to 0.9 to accommodate the long persistence. Figure 4 shows the dynamic responses corresponding to fiscal rules (ii) and (iii).

Figure 4: Impulse response functions for a negative risk premium shock in a non-EMU scenario.



Note: The solid line is the dynamic response of conventional fiscal rule (ii); the dotted line shows the current account stabilizing fiscal rule (iii).

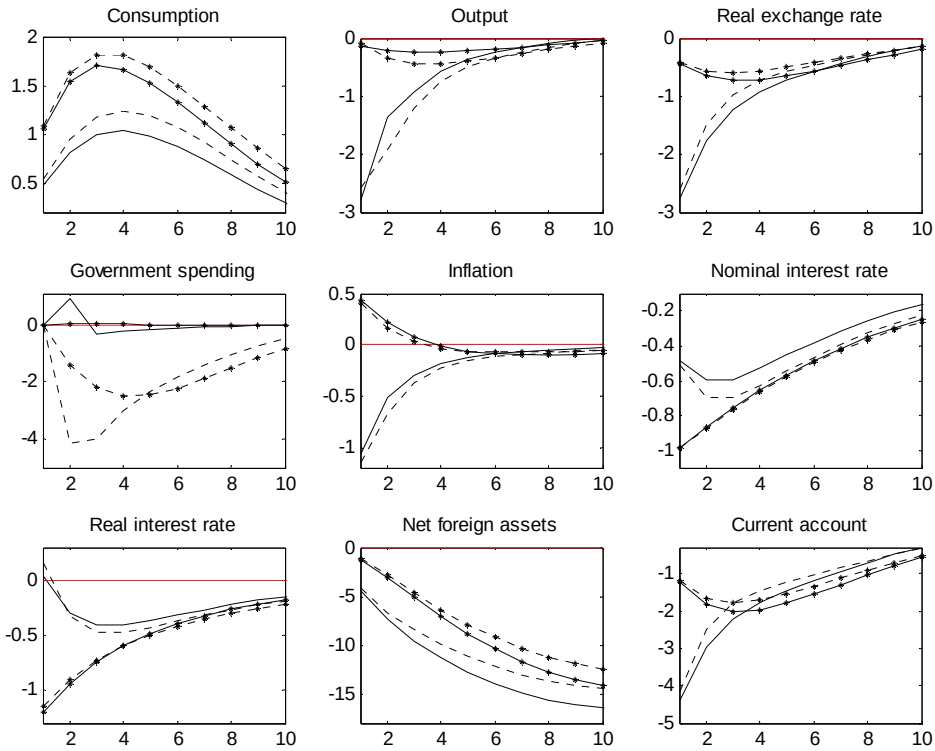
Similar to negative productivity shock, we start analyzing the dynamic responses in the non-EMU scenario.[22]. A negative risk premium shock lowers nominal interest rates and induces an appreciation of the real exchange rate. The loss in competitiveness lowers output and the current account. A decrease in domestic inflation, caused by lower marginal costs, reduces the real interest rate and raises consumption. Due to the decrease in output, conventional fiscal policy (solid line) increase government spending

[22] The standard deviations for the risk premium shock in the non-EMU and EMU scenario can be found in table A2 and A3 at the appendix.

in order to stabilize output. A current account stabilizing fiscal rule (dotted line) decreases government spending and reduces the variability of real exchange rate and current account deficit. Analogously to the productivity shock, the stabilizing effects for the current account are accompanied by a higher variability of output.

In the next step we analyze the effects when the small open economy is inside the EMU. Considering only the stabilizing effects for fiscal rules (ii) and (iii) in the EMU scenario (*-marked lines in figure 5), similar results as for the non-EMU scenario become evident. Hence, a fiscal response to the current account (*-dotted lines) stabilizes the current account and real exchange rate, but is accompanied with higher variability of the output.

Figure 5: Impulse response functions for a negative risk premium shock in the EMU and non-EMU scenario.



Note: The solid and dotted lines are the dynamic responses of fiscal rules (ii) and (iii) of figure 4 (non-EMU scenario) as a benchmark. The marked (*) solid and dotted lines show the effects of fiscal rule (ii) and (iii) in the EMU-scenario, respectively.

Comparing the dynamic responses for both scenarios, the EMU scenario reveals remarkable effects for the variability of macroeconomics variables that are contrary to those for the negative productivity shock. Therefore, entry into EMU diminishes the volatility for most macroeconomic variables, especially in the first four quarters. This is due to the absence of nominal exchange rate fluctuations. In the non-EMU scenario, nominal exchange rate appreciates rapidly of about 3% and remains almost at the higher level. This leads to a stronger appreciation of the real exchange rate and a more drastic decline in output which worsens the current account. Due to the loss of monetary policy in the EMU scenario, nominal interest rate is more affected by a negative risk premium shock. Therefore, the increase in consumption variability is caused by a sharp decrease in the real interest rate.

Comparing the stabilizing properties of alternative fiscal policy rules, similar results as for the negative productivity shock become evident. A countercyclical fiscal response to the current account stabilizes most macroeconomic variables better than a conventional countercyclical response to output, independently of the underlying exchange rate regime. But, stabilizing the current account via fiscal policy intervention is accompanied by higher variability of output. Furthermore, on the contrary to the productivity shock, entry into EMU implies lower variability of most macroeconomic variables, e.g. output, real exchange rate, current account, but a higher persistence in the adjustment process of the current account. The higher variability in the first four quarters of the non-EMU scenario is due to the high and persistent nominal exchange rate appreciation which leads to a higher real exchange rate appreciation. The decrease in competitiveness produces higher negative output growth and higher current account deficits.

5 Robustness

For a better insight in the robustness of our simulation results, we check the relative efficiency of alternative values for fiscal smoothing ρ_g and current account feedback term ω_{ca} for a negative productivity shock. Therefore, we run simulations over a range of the parameters in the interval $[0;0.9]$ and $[-1;2]$ in steps of 0.1 and 0.25, respectively. Assuming monetary policy follows the rules according to (28) and (27) for the non-EMU and EMU scenario, figure 6 shows the efficiency of an increasing smoothing parameter with respect to the variances of inflation and output growth for a negative productivity shock. The other parameters of the fiscal policy rule follow the baseline calibration as in equation (31):

$$g_t = \rho_g g_{t-1} + (1-\rho_g)(-0.4(y_{t-1} - y_{t-2}) - 0.02b_{t-1} + 1.5ca_{t-1}) + \varepsilon_{g,t}$$

Figure 6: Efficiency frontier for alternative values of smoothing parameter ρ_g in the non-EMU (left figure) and the EMU scenario (right figure).

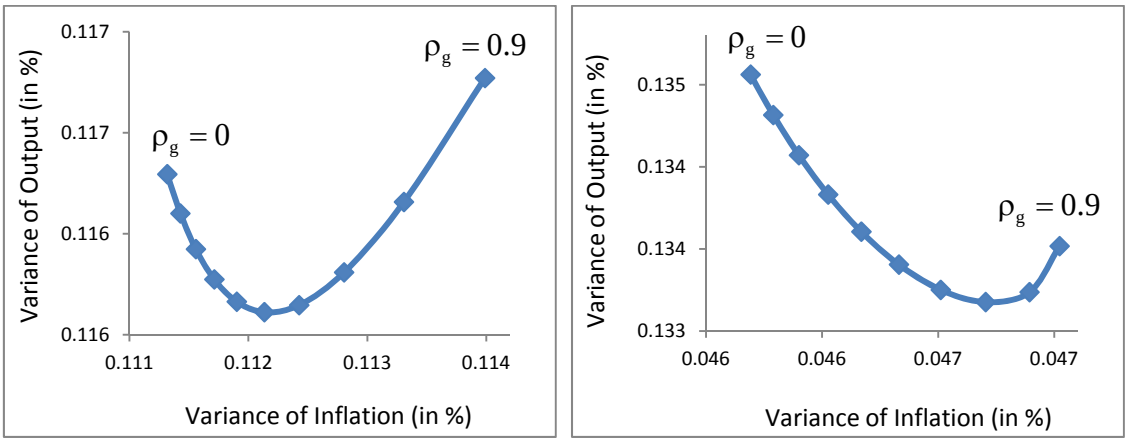
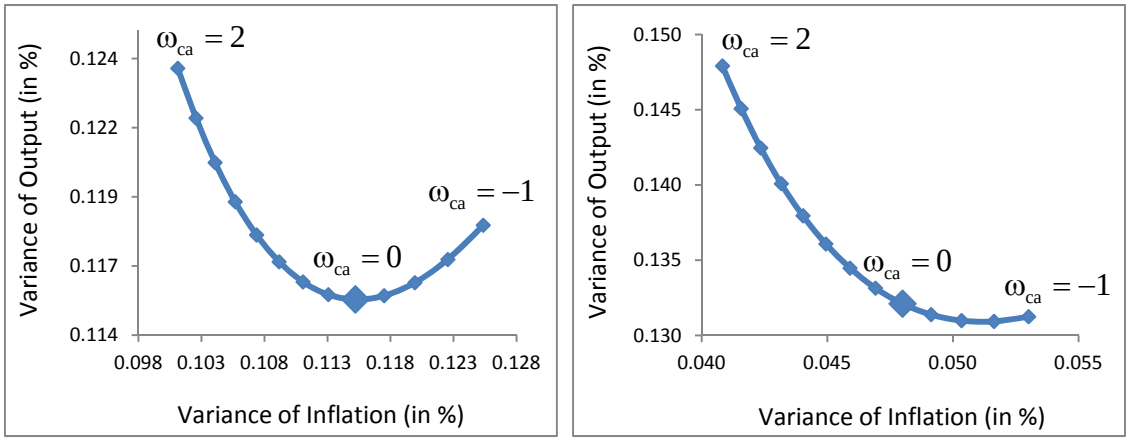


Figure 6 shows the differences between the two monetary regimes. As can be seen, the government faces a trade-off between stabilizing output and inflation in both scenarios. The trade-off diminishes the less flexible the government is to adjust fiscal policy. The minimum in the non-EMU scenario is at a fiscal persistence of around 0.5, whereas it is only from 0.8 onwards in the EMU scenario. It seems that fiscal policy in the EMU scenario has a wider scope in stabilizing output and inflation, even if government is less

flexible to adjust fiscal policy. Figure 6 also confirms the findings in section 4 that volatility of output is higher in a currency union.

The effects of alternative values of the current account feedback term ω_{ca} are displayed in figure 7, which illustrates how the variances of output and inflation react to changes in the current account response ranging from -1 up to 2. If $\omega_{ca} = 0$, the results for conventional fiscal policy rule without reaction to current account imbalances are obtained. Figure 7 confirms the findings in section 4 that the higher the current account stabilizing response, the higher the variability of output, independently of the underlying exchange rate regime. It shows that fiscal policy faces a trade-off between stabilizing output and inflation.

Figure 7: Efficiency frontier for current account feedback interval [-1;2] in the non-EMU (left figure) and the EMU scenario (right figure).



6 Conclusion

The paper analyzes the stabilizing potential of fiscal policy for current account imbalances in a small open economy. Examining two monetary regimes, i.e. an economy inside and outside of EMU, we introduce alternative fiscal policy rules to allow for an endogenous reaction of fiscal policy to changes in the current account. Within this approach, we analyze how fiscal policy as a stabilization tool affects the adjustment of the current account and other macroeconomic variables to productivity and risk premium shocks.

We find that the entry into the EMU and the accompanying loss of an autonomous monetary policy makes the economy more vulnerable to a productivity shock with higher variability of output, real exchange rate and current account in the short run and higher persistence of the real exchange rate. On the contrary, for a risk premium shock, entry into EMU implies lower variability of most macroeconomic variables, e.g. output, real exchange rate, current account, but a higher persistence in the adjustment process of the current account. For both shocks, inside as well as outside of EMU a fiscal response to the current account can help stabilizing most of macroeconomic variables, e.g. real exchange rate, net foreign assets and the current account, but at the expense of higher output variability in the short run. Hence, fiscal policy faces a trade-off between stabilizing current account and output.

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Appendix A

Table A1: Baseline calibration.

Parameter	**Symbol**	**Value**
Discount factor	β	0.99
Coefficient of relative risk aversion / Invers of elasticity of intertemporal substitution	σ	1.5
Elasticity of labor supply	$1/\varphi$	0.25
Elasticity of substitution between domestic and foreign goods	η	1.5
Degree of openness	α	0.4
Habit persistence	h	0.7
Calvo price stickiness	θ	0.75
Government spending share in GDP	ρ_{gov}	0.2
Debt elasticity of interest rate	χ	- 0.01
Interest rate smoothing	ρ_i	0.75
Feedback coefficients of inflation	ω_π	1.5
Feedback coefficients of output gap	$\omega_{\hat{y}}$	0.125
Government instrument smoothing	ρ_g	0.2
Automatic stabilizer	ω_g	- 0.4
Debt elasticity of government spending	ω_b	- 0.02

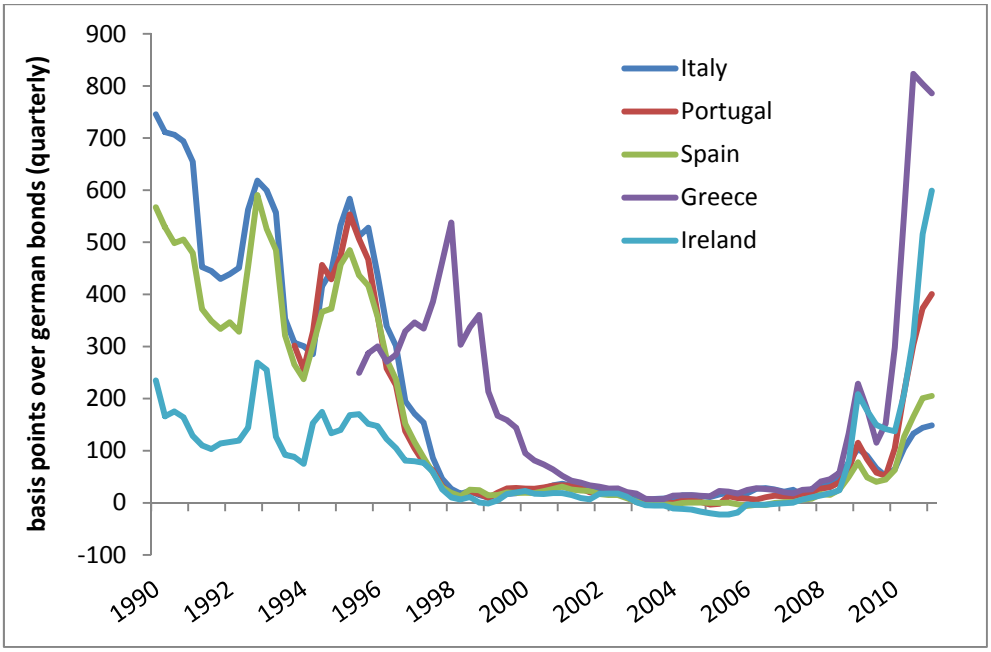
Table A2: Standard deviations for a negative risk premium shock in the non-EMU scenario.

Variable	Standard Deviations in % (non-EMU scenario)			
Fiscal policy rule	(i)	(ii)	(iii)	(iv)
	$g_t = 0$	$\omega_g = 0.4$ $\omega_{ca} = 0$	$\omega_g = 0.4$ $\omega_{ca} = 1.5$	$\omega_g = 1.00$ $\omega_{ca} = 1.52$
Consumption	3.0557	3.0595	3.7567	3.7674
Output growth	3.3982	3.3703	3.6679	3.6203
Real exchange rate	3.9081	3.9155	3.4617	3.4718
Government spending	0.0000	0.9861	8.4664	8.4101
Inflation	1.2526	1.2454	1.4204	1.4115
Interest Rate	1.3753	1.3731	1.6281	1.6267
Net foreign assets	74.2345	74.1871	68.6447	68.5366
Current account	6.9018	6.9129	6.1493	6.1635

Table A3: Standard deviations for a negative risk premium shock in the EMU scenario.

Variable	Standard Deviations in % (EMU scenario)			
Fiscal policy rule	(i)	(ii)	(iii)	(iv)
	$g_t = 0$	$\omega_g = 0.4$ $\omega_{ca} = 0$	$\omega_g = 0.4$ $\omega_{ca} = 1.5$	$\omega_g = 1.78$ $\omega_{ca} = 2.54$
Consumption	4.3901	4.3895	4.9343	5.2537
Output growth	0.7406	0.7388	1.1783	1.4234
Real exchange rate	1.9046	1.9056	1.5055	1.2958
Government spending	0.0000	0.0713	6.7336	10.4458
Inflation	0.5549	0.5562	0.4842	0.4533
Interest Rate	1.9834	1.9687	1.9969	2.0123
Net foreign assets	65.2263	65.2210	60.4933	57.7807
Current account	5.2359	5.2375	4.6022	4.2684

Figure A1: 10-year government bond spreads.



Source: IHS Global Insight.

Appendix B

Log-linear model

The model is log-linearized around a non-stochastic steady state, so that variables are expressed in percent deviations from their respected steady state value. A log-linear approximation of the domestic household's Euler equation (10) gives

$$c_t - hc_{t-1} = E_t\left(c_{t+1} - hc_t\right) - \frac{1}{\sigma}(1-h)\left(i_t - E_t\left\{\pi_{t+1}\right\} - \varepsilon_{pref}\right). \tag{35}$$

In the absence of habit formation – by setting $h = 0$ – one obtains the standard Euler equation.

The market clearing condition implies that the economy's output can either be consumed domestically or exported to the foreign country, therefore we can write:

$$y_t = (1-\rho_{gov})(1-\alpha)c_{H,t} + \alpha c_{F,t} + \rho_{gov} g_t \tag{36}$$

By using the log-linearized versions of the two demand functions (6) and (7) $c_{H,t} = -\eta(p_{H,t} - p_t) + c_t$ and $c_{F,t} = -\eta(p_{F,t} - p_t) + c_t^*$, the CPI definition (8) $p_t = (1-\alpha)p_{H,t} + \alpha p_{F,t}$, and the terms of trade definition (19) $s_t = p_{F,t} - p_{H,t}$, we can derive the following goods market clearing condition

$$y_t = (1-\rho_{gov})(1-\alpha)(c_t + \alpha\eta s_t) + \alpha(\eta(s_t + \psi_t) + c_t^*) + \rho_{gov} g_t, \tag{37}$$

where $\psi_{F,t} = (e_t + p_t^*) - p_{F,t}$ denotes the law of one price gap. Notice that for a large foreign economy, output equals domestic consumption $c_t^* = y_t^*$.

First order condition (12) implies the log-linear equation for newly set prices:

$$p_{H,t}^{new} = (1-\beta\theta_H)E_t\left[\sum_{T=t}^{\infty}\left(\beta\theta_H\right)^{T-t}\left(mc_t + p_{H,t}\right)\right]. \tag{38}$$

The evolution of the domestic aggregate price index is given by

$$P_{H,t} = \left[\theta_H\left(P_{H,t-1}\right)^{1-\varepsilon} + \left(1-\theta_H\right)\left(P_{H,t}^{new}\right)^{1-\varepsilon}\right]^{\frac{1}{1-\varepsilon}}. \tag{39}$$

Combining (38) with the log-linearized version of (39) yields the forward-looking Phillips curve relating domestic inflation and real marginal cost:[23]

$$\pi_{H,t} = \beta E_t\left\{\pi_{H,t+1}\right\} + \kappa_H mc_t + \varepsilon_{\pi_H,t}, \tag{40}$$

where $\kappa_H \equiv \left(\frac{(1-\theta_H)(1-\beta\theta_H)}{\theta_H}\right)$ and $\varepsilon_{\pi_H,t}$ is an exogenous AR(1) shock to domestic inflation.

Differentiating the real total cost $TC_t = \frac{W_t}{P_{H,t}}\frac{Y_t}{A_t}$ w.r.t. Y_t gives the real marginal cost in logs:

$$mc_t = (w_t - p_{H,t}) - a_t. \tag{41}$$

The log-linearized intratemporal labor/leisure choice (9) is given by:

$$w_t - p_t = \sigma\frac{\left(c_t - hc_{t-1}\right)}{\left(1-h\right)} + \varphi n_t. \tag{42}$$

Combining equations (41) and (42), the production function in logs $y_t = a_t + n_t$, and the Terms of Trade definition, we can derive the equilibrium condition for the domestic real marginal cost:

$$mc_t = \varphi y_t + \alpha s_t + \frac{\sigma}{1-h}\left(c_t - hc_{t-1}\right) - \left(1+\varphi\right)a_t. \tag{43}$$

Similarly, foreign goods price inflation follows a forward-looking Phillips curve and is given by:

$$\pi_{F,t} = \beta E_t\left\{\pi_{F,t+1}\right\} + \kappa_F \psi_{F,t} + \varepsilon_{\pi_F,t}, \tag{44}$$

where $\kappa_F = \left(\frac{(1-\theta_F)(1-\beta\theta_F)}{\theta_F}\right)$, $\psi_{F,t}$ is the law of one price gap and $\varepsilon_{\pi_F,t}$ is an exogenous AR(1) shock to imported goods inflation.

The domestic consumer price index (8) in log-linear form is therefore defined as:

$$\pi_t = \left(1-\alpha\right)\pi_{H,t} + \alpha\pi_{F,t}. \tag{45}$$

The change in the Terms of Trade (19) can be expressed in terms of the relative inflation rates between foreign goods and domestic goods:

[23] For a detailed derivation see the appendix in Gali and Monacelli (2005).

$$\Delta s_t = \pi_{F,t} - \pi_{H,t} . \tag{46}$$

By combining the real exchange rate (20) with the l.o.p. gap, the log real exchange rate can be expressed as:

$$q_t = \psi_{F,t} + (1-\alpha)s_t , \tag{47}$$

where the log terms of trade is defined as $s_t = p_{F,t} - p_{H,t}$. Equation (47) shows that the real exchange rate is positively related to both, the l.o.p. gap and Terms of Trade.

Time differencing the real exchange rate yields the relationship between real and nominal depreciation rates as follows:

$$q_t - q_{t-1} = \Delta e_t + \pi_t^* - \pi_t . \tag{48}$$

The uncovered interest parity condition (15), expressed in logs, becomes

$$i_t - i_t^* - \phi_t = E_t \left\{ \Delta e_{t+1} \right\} \tag{49}$$

with

$$\phi_t = -\chi nfa_t - \varepsilon_{risk,t} . \tag{50}$$

Equation (39) captures a time-varying country risk premium and is the sum of the net foreign asset position of the domestic country and an exogenous component $\varepsilon_{risk,t}$, which follows an AR(1) process. The term χ is an elasticity parameter negatively related to the net foreign asset position. The UIP can also be written as:

$$\left(i_t - E_t \left\{ \pi_{t+1} \right\}\right) - \left(i_t^* - E_t \left\{ \pi_{t+1}^* \right\}\right) - \phi_t = E_t \left\{ \Delta q_{t+1} \right\} \tag{51}$$

and implies that expected changes in real exchange rate are determined by current real interest rate differentials.

The real net foreign asset position, equation (21) and (22), evolves over time according to

$$nfa_t = (1 + i_{t-1} - \pi_H)\phi_{t-1} nfa_{t-1} + nx \tag{52}$$

with $nx = y_t - (1-\rho_{gov})c_t - (1-\rho_{gov})\alpha(s_t + \psi_{F,t}) - \rho_{gov} g_t$ and $nfa_t = \dfrac{e_t NFA_t}{P_t}$.

Given the evolution of assets determined by the model, we may express the current account as the change in net foreign assets:

$$ca_t = nfa_t - nfa_{t-1} . \tag{53}$$

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